TESTS ON A MODEL OF THE WOYEVODSKY TYPE VII MONOPLANE.

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Summary.—(a) *Introductory* (*Reasons for inquiry*).—The experiments were undertaken at the request of the Air Ministry with a view to providing data regarding the aerodynamic properties of the Woyevodsky monoplane.

(b) *Range of the investigations.*—The observations comprised measurements of lift and drag forces on the model at 40 ft/sec. for angles of incidence from $-4°$ to $+18°$. From the results pitching moments about the C.G. were calculated. Tests were made both with and without the tail plane in position.

(c) *Results and conclusions.*—The maximum value of L/D was 11·3 and the design shows superiority over the previous design W4 throughout the whole of the flying range.

Introductory.—The tests described in this report were undertaken at the request of the Air Ministry. The general features of the Woyevodsky design are described in R. & M. 571, which gives the results of tests on an earlier Woyevodsky model known as the W.4. This was a model to a scale of 1/15·5 of a single engine two-seater machine having a span of 42 ft. The model most recently tested, known as the W.7, was constructed to a scale of 1/36 and represented a design for a heavy twin engine load-carrying machine to accommodate 20 to 24 passengers and having a span of 100 ft.

Description of the model.—A drawing of the model is given in Fig. 1. The essential feature of the Woyevodsky design is that the aerofoil section is maintained throughout the entire machine, and this feature is reproduced in the W.7. In other respects the design is somewhat different from that of the W.4. The upper surface of the wings is not continuous with the fuselage as was previously the case; and the rear portion of the body is curved upwards so that at 0° incidence of the wing chord, the plane of the tail is considerably above that of the main planes. The tail setting on the model was $+0°·7$. Fig. 1a shows a section of the main plane taken 1″·25 from the intersection of the wing and the fuselage. It will be seen that the section is of the R.A.F.15 type, but is considerably thicker to allow for the deep spars necessitated by the elimination of external wing bracing. As in the W.4 the wings decrease in thickness from root to tip, and the leading edge has a considerable sweep-back.

Range of the investigations.—The model was tested on wires in the usual manner in the 4-ft. No. 2 wind channel. Tests were made both with and without the tail plane and fin in position and comprised measurements from which values of lift, drag and pitching moment about the C.G. were calculated for angles of incidence ranging from $-4°$ to $+18°$. The majority of the observations were made at a wind speed of 40 ft/sec., but in the region of maximum lift there appeared to be a scale effect which gave a gap in the lift curve. Accordingly a few extra tests were carried out in this region at a wind speed of 60 ft/sec., and reduced to 40 ft/sec. This had the effect of bridging the gap, as will be seen by reference to Fig. 2.

The tail plane and fin were made in one piece fitting into a recess in the rear of the fuselage. When making the tests with this portion removed, the recess was filled in with plasticine and faired to conform to the general curvature of the fuselage in this neighbourhood.

Results and Conclusions.—The results of the tests are given in Tables 1 and 2 and Figs. 2, 3, 4 and 5. The same difficulty as regards effective wing area existed as in the case of W.4, as the fuselage, owing to its peculiar conformation, formed part of the supporting surface, and, therefore, any attempt to give the results in the form of force coefficients might be misleading. Lift, drag and pitching moments are, therefore, given as the calculated forces and moments acting on the model.

No information was available respecting the z co-ordinate of the C.G. of the full-scale machine, only the x co-ordinate being indicated on the model. Accordingly for the evaluation of the pitching moment, the z co-ordinate was assumed to lie on the axis of thrust, the position of which could be obtained within reasonable limits from measurements made on the model. Since, however, the x co-ordinate is the factor which determines the larger portion of the pitching moment, any errors involved in the assumption of the z co-ordinate are relatively unimportant. It is estimated that an error of 25 per cent. in this length would cause a maximum error of 5 per cent. in the value of pitching moment, this maximum error occurring at 16° incidence. At smaller angles the discrepancy would be considerably less.

Reference to Fig. 4 shows that the maximum value of L/D for the model was 11·3 at 6°·5 incidence as compared with 10·8 for the W.4.

The pitching moment curves (Fig. 5) show one or two points of interest. The slope of the curve for the complete machine does not as a whole increase with increasing angle of incidence, as is usually the case.

The tail area could be made somewhat larger, or better still, the C.G. placed slightly further forward, as it appears from the curve that the present tail provides very little increase of restoring moment for increasing angles of attack between 6° and 14° incidence. This reduced efficiency of the tail plane at the larger angles of incidence is probably due to the shielding effect of the main planes and fuselage which would be expected to occur at these angles owing to the relative position of tail and wings. If this explanation is correct, better stability at high angles of incidence might be obtained if the tail could be mounted still farther above the main plane chord, so that it would not be immediately behind the main planes until after the stalling angle was reached.

It should be noted that for longitudinal equilibrium at normal flying angles with elevators at zero the tail plane should have been set at a slightly smaller angle than that on the model, the present moment curve (Fig. 5) indicating a position of stable equilibrium at an angle of incidence of about — 4°

TABLE 1.

FORCES AND MOMENTS ON MODEL WITH TAILPLANE AND FIN IN POSITION.

Wind Speed, 40 ft/sec.

Angle of Incidence (degrees).	Lift (lbs.).	Drag (lbs.).	L/D.	Pitching Moment about C.G. (lbs/ft.).
− 4	− 0·713	0·1361	− 5·24	+ 0·00183
− 2	− 0·122	0·1125	− 1·08	− 0·0163
0	+ 0·439	0·1091	+ 4·03	− 0·0331
+ 2	0·914	0·1196	7·64	− 0·0436
4	1·447	0·1441	10·04	− 0·0638
6	2·045	0·1823	11·21	− 0·0774
8	2·519	0·2287	11·01	− 0·0789
10	2·945	0·2837	10·38	− 0·0862
12	3·390	0·3500	9·69	− 0·0826
14	3·765	0·5172	7·28	− 0·0852
16	3·38	0·7966	—	—
18	3·60	0·8942	4·03	(− 0·182)
10	3·060*	—	—	—
12	3·455*	—	—	—
14	3·831*	—	—	—
16	4·189*	—	—	—
17	4·315*	—	—	—

* Observations made at a wind speed of 60 ft/sec. and reduced to 40 ft/sec.

TABLE 2.

FORCES AND MOMENTS ON MODEL WITH TAIL PLANE AND FIN REMOVED.

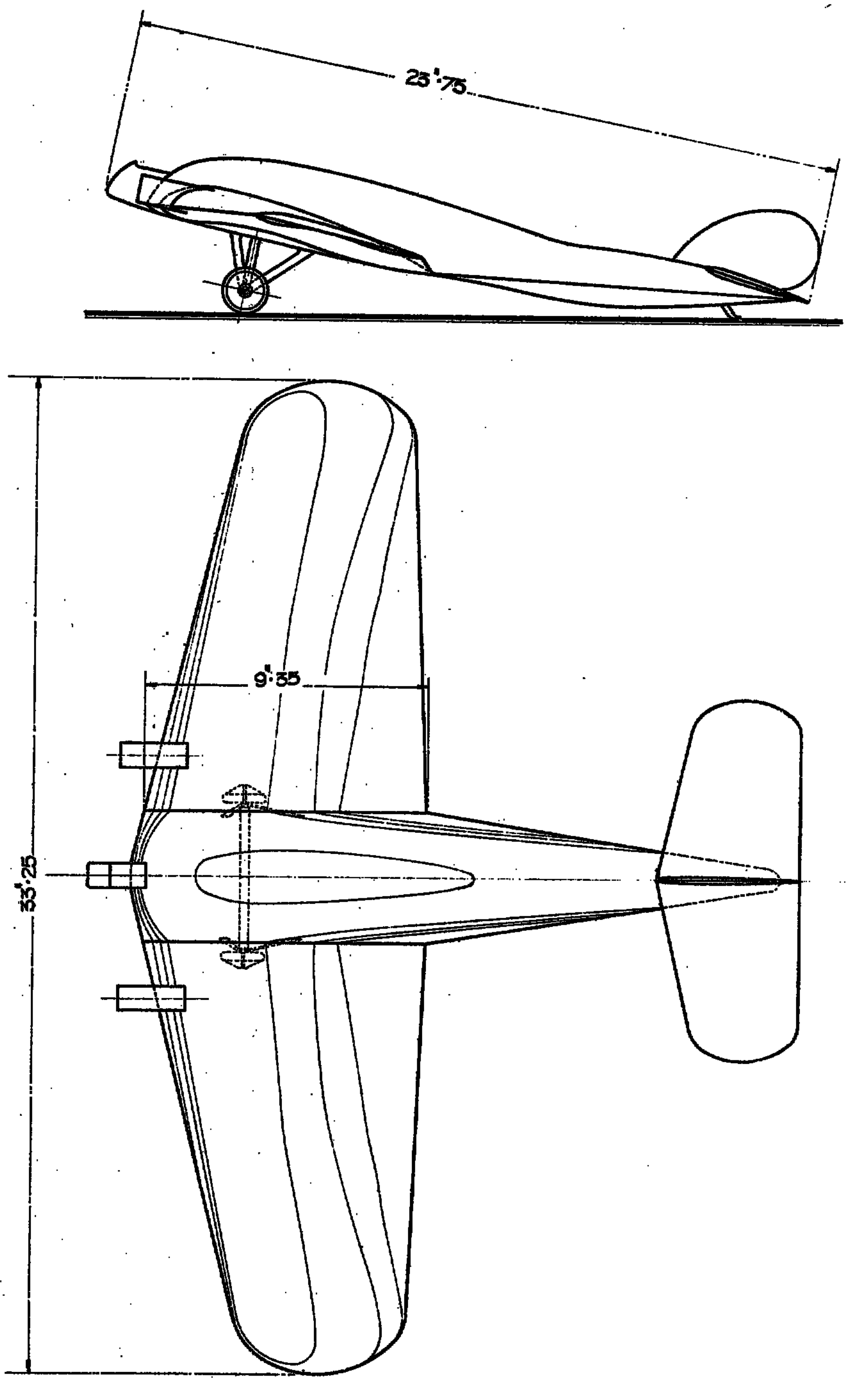
Wind Speed, 40 ft/sec.

Angle of Incidence (degrees).	Lift (lbs.).	Drag (lbs.).	L/D.	Pitching Moment about C.G. (lbs/ft.).
− 4	− 0·510	0·1191	− 4·28	− 0·1322
− 2	+ 0·031	0·0973	+ 0·32	− 0·0982
0	0·471	0·0972	4·84	− 0·0689
+ 2	0·952	0·1060	8·99	− 0·0268
4	1·476	0·1275	11·58	+ 0·0069
6	1·982	0·1640	12·09	0·0428
8	2·376	0·2020	11·76	0·0727
10	2·728	0·2518	10·83	0·1270
12	3·183	0·3050	10·43	0·1464
14	3·584*	0·3510*	10·20	0·1851
16	3·946*	0·4180*	9·44	0·2293

* Observations made at a wind speed of 60 ft/sec. and reduced to 40 ft/sec.

Fig. 1.

Tests on Model of Woyevodsky (Type VII) Monoplane.



Details of Model shewing contours of Wings and Fuselage.

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Fig. 1A.

Tests on Model of Woyevodsky (Type VII) Monoplane.

Section of Wing near to Body.

(R.A.F.15. Section Dotted.)

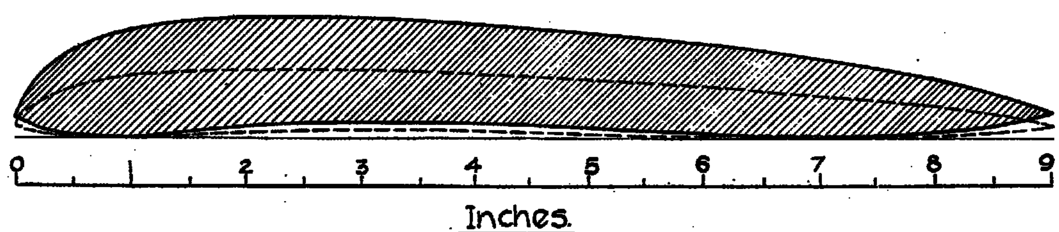

FIG. 2.

Tests on Model of Woyevodsky (Type VII) Monoplane.

Variation of Lift with Angle of Incidence.

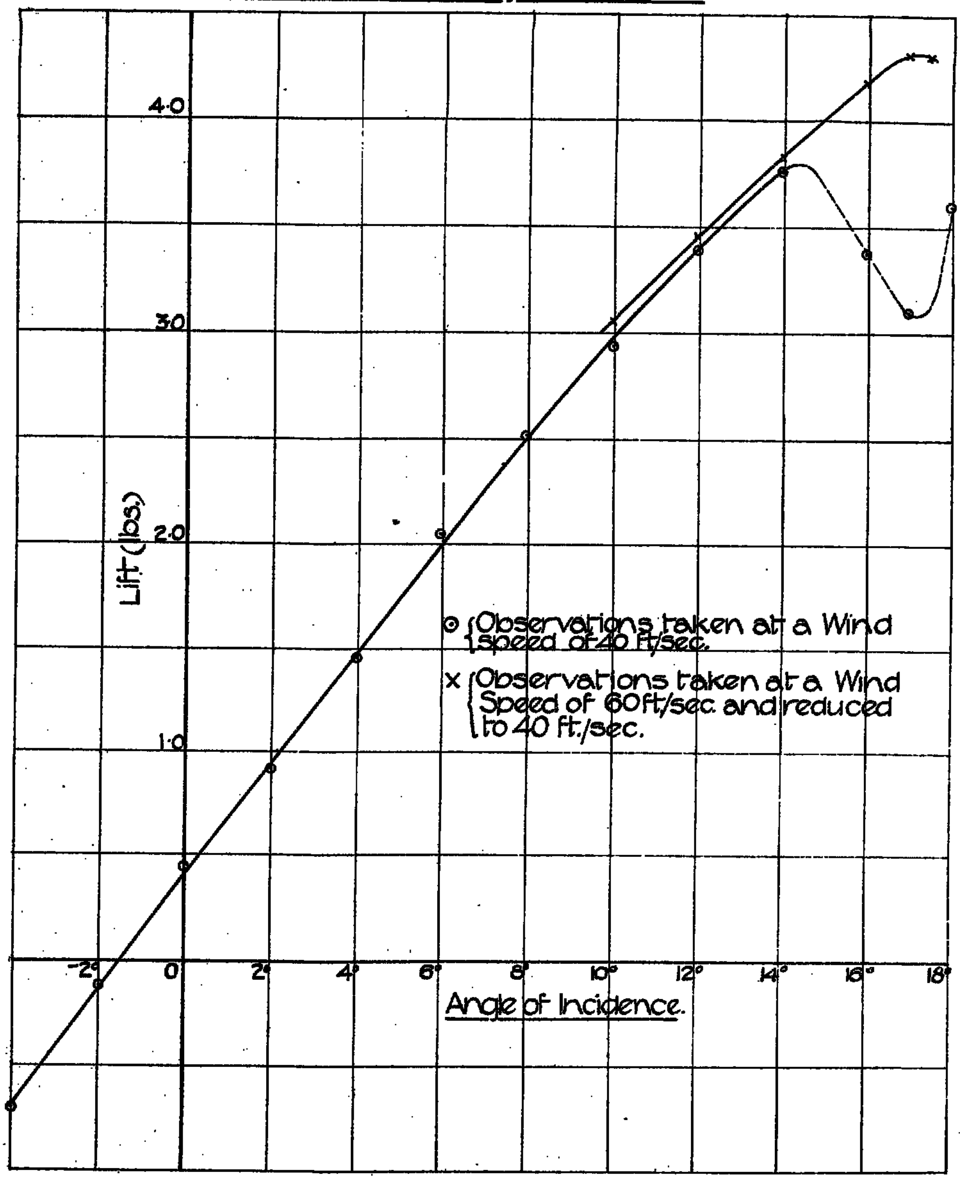

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FIG. 3.

Tests on Model of Woyevodsky (Type VII) Monoplane.

Variation of Drag with Angle of Incidence.

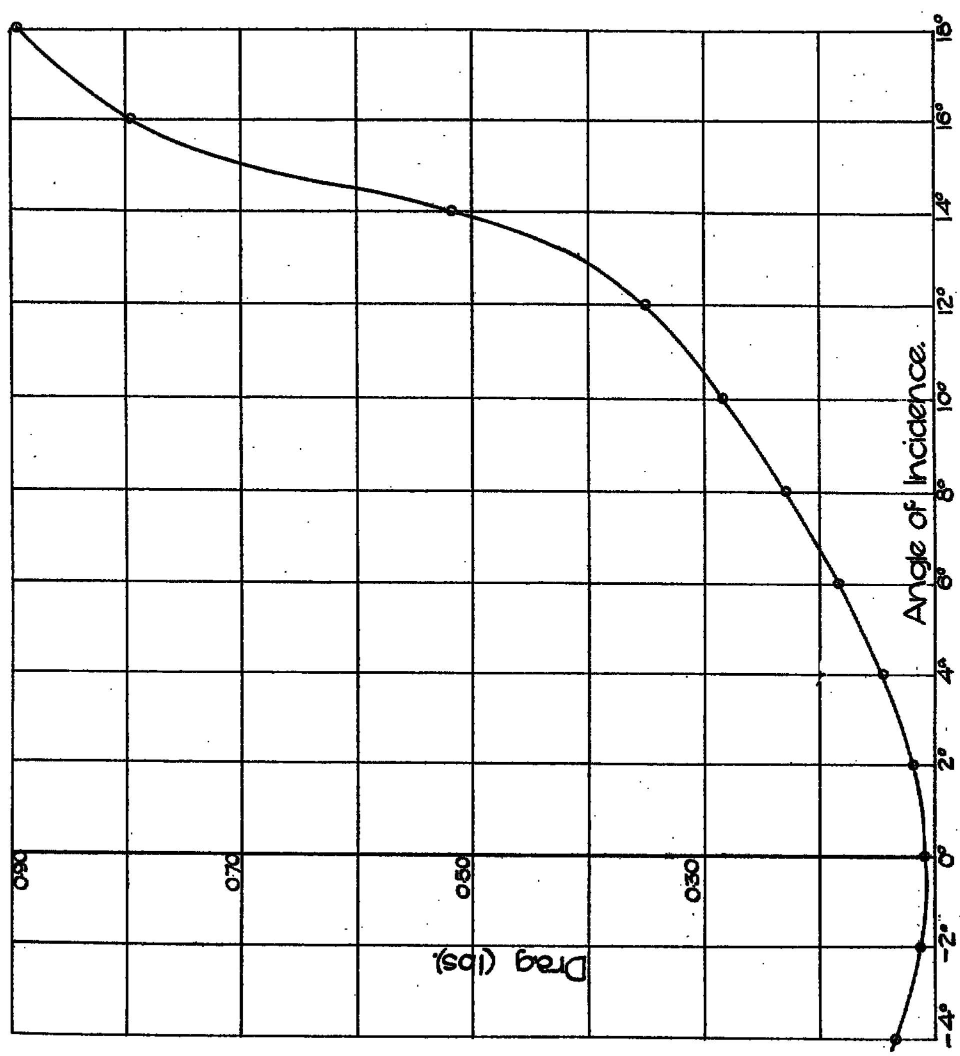

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FIG. 4.

Test on Model of Woyevodsky (Type VII) Monoplane.

Variation of Ratio L/D with Angle of Incidence.

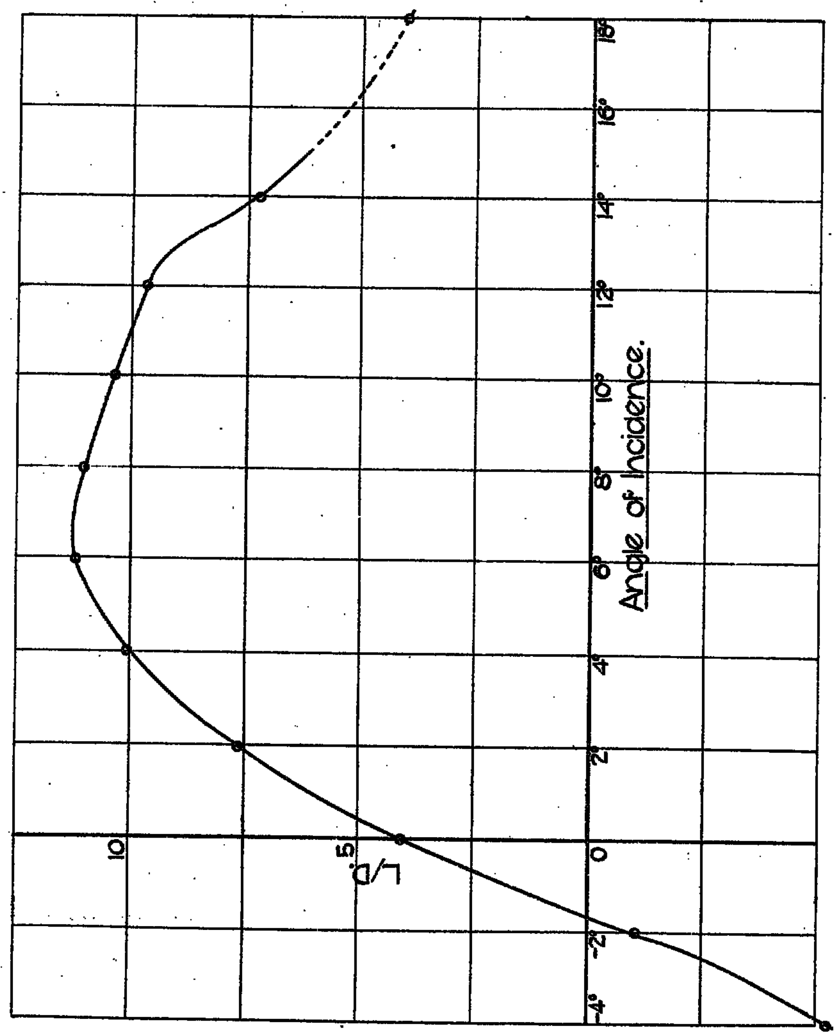

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FIG. 5.

Tests on Model of Woyevodsky (Type VII) Monoplane.

Variation of Pitching Moment about C.G. with Angle of Incidence.